

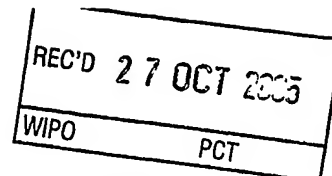
PATENT COOPERATION TREATY


PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference HSP 1665 PCT		FOR FURTHER ACTION - See Form PCT/PEA416	
International application No. PCT/GB2004/003301		International filing date (day/month/year) 30.07.2004	Priority date (day/month/year) 31.07.2003
International Patent Classification (IPC) or national classification and IPC C01B3/00			
Applicant JOHNSON MATTHEY PUBLIC LIMITED COMPANY et al.			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 3 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input checked="" type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand 27.05.2005		Date of completion of this report 26.10.2005	
Name and mailing address of the International preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer Werner, H Telephone No. +49 89 2399-8571	



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/003301

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-8 as originally filed

Claims, Numbers

1-15 received on 01.06.2005 with letter of 27.05.2005

Drawings, Sheets

1/7-7/7 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/003301

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-14
	No: Claims	15
Inventive step (IS)	Yes: Claims	1-14
	No: Claims	15
Industrial applicability (IA)	Yes: Claims	1-15
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VI Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

see separate sheet

SECTION V

1. Novelty and inventive step (Art 33(2) and (3) PCT)

1.1. The following documents are referred to in this communication:

D1 : US 4 214 699 A

D2 : US 5 906 792 A

1.2 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 15 is not new in the sense of Article 33(2) PCT. Document D1 discloses (in particular: Figs 1 and 2 and column 2, line 46 - column 3, line 21) a hydrogen supply system comprising TiFe as low temperature hydride material and Mg_2Ni as high temperature hydride material. The low temperature hydride material is activated and releases hydrogen. The hydrogen released from the low temperature hydride material is transported to the high temperature hydride material and to a motor. The high temperature hydride material is activated by the hydrogen from the low temperature hydride material and releases hydrogen.

Hence, the subject-matter of claim 15 is not new vis-a-vis D1.

1.3. Document D2 discloses (in particular: column 2, lines 39-56; column 2, line 65 - column 3, line 33; column 6, lines 41-48) a high temperature metal hydride activated by a low temperature metal hydride.

Hence, the subject-matter of claim 15 is not new vis-a-vis D2.

1.4. The subject-matter of claims 1-14 seems to relate to new and inventive matter. A hydrogen supply system comprising two separate hydrogen storage materials is claimed. The first hydrogen storage material can be activated to release hydrogen at a lower temperature than can the second hydrogen storage material. The second hydrogen storage material is activated by burning a portion of the hydrogen released from the first hydrogen storage material in a hydrogen burner unit. The first hydrogen storage material is readily activated and thus enables a quick start-up. The second hydrogen storage material has a high hydrogen storage capacity. Therefore, with this system quick start-ups combined with high storage

capacity is obtained.

The closest prior art is represented by US 2003/162059 A1. This document discloses a system comprising a hydrogen supply system comprising a low temperature hydride material and a high temperature hydride material. The low temperature hydride material is activated and releases hydrogen. The hydrogen released from the low temperature hydride material is transported to the high temperature hydride material. The high temperature hydride material is activated by the hydrogen from the low temperature hydride material and releases hydrogen. The bonding energy for hydrogen in the high temperature hydride is at least twice the amount the energy consumed in the low temperature hydride by desorbing hydrogen. Burning the hydrogen is not disclosed.

Further document cited:

US-A-4 214 699 discloses a high temperature metal hydride activated by a low temperature metal hydride. The materials are not separated. Burning the hydrogen is not disclosed.

SECTION VI

2. The document US-A-5 906 792 could be relevant in a later European phase.

01.06.2005

(102)

CLAIMS

1. A hydrogen supply system, the system comprising a first hydrogen storage material (1) and a second hydrogen storage material (2), wherein the two hydrogen stores are separate; and wherein the first hydrogen storage material can be activated to release hydrogen at a lower temperature than can the second hydrogen storage material; wherein at least a proportion of the hydrogen released from the first hydrogen storage material is utilised to activate the second hydrogen storage material; and wherein at least a proportion of the hydrogen released from the second hydrogen storage material is made available to a hydrogen consumption system (3), and wherein the second hydrogen storage material (2) is activated by oxidising a proportion of the hydrogen released from the first hydrogen storage material (1) in a hydrogen burner unit (4).
2. A system according to claim 1, wherein a proportion of the hydrogen released from the first hydrogen storage material (1) is made available to the hydrogen consumption system (3).
3. A system according to any preceding claim, wherein a proportion of the hydrogen released from the second hydrogen storage material (2) is used to recharge the first hydrogen storage material (1).
4. A system according to any preceding claim, wherein the first hydrogen storage material (1) can be activated to release hydrogen at a temperature of less than 100 °C.
5. A system according to any preceding claim, wherein the second hydrogen storage material (2) can be activated to release hydrogen at a temperature of from 250 °C to 350 °C.

6. A system according to any preceding claim further comprising one or more heat exchangers (5) to remove heat from the hydrogen released from the first (1) or second (2) hydrogen storage materials.
7. A system according to any preceding claim, wherein the first hydrogen storage material (1) comprises an AB₅, AB₂ or an AB type material.
8. A system according to claim 7, wherein the first hydrogen storage material (1) is LaNi₅, Al doped LaNi₅, CeNi₅, Al doped CeNi₅, CaNi₅, Mn doped CaNi₅, TiVMn, Zr doped TiCrMn, Zr doped TiCr₂, Co doped TiV₂, Fe/Ti, Ti/Zr, Ti(MnV) and Ti(MnCr), or any combination thereof.
9. A system according to any preceding claim, wherein the second hydrogen storage material (2) comprises Mg.
10. A system according to claim 9, wherein the second hydrogen storage material (2) comprises PGM.
11. A system according to claim 9 or 10, wherein the second hydrogen storage material (2) is MgH₂ or Mg H₂/Ni, or any combination thereof.
12. A system according to any preceding claim, wherein the hydrogen consumption system (3) comprises a fuel cell.
13. A system according to any of claims 1 to 11, wherein the hydrogen consumption system (3) comprises an internal combustion engine.
14. A vehicle, the vehicle comprising a system according to claim 12 or claim 13 as a power source.
15. A method of activating a second hydrogen storage material (2) for supplying a hydrogen consumption system (3), which method comprising utilising at least a

proportion of a stream of hydrogen generated by activating a separate first hydrogen storage material (1).